Lower Paleozoic stratigraphy of northwestern Melville Island, District of Franklin

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Abstract

The Lower Paleozoic succession in the Canrobert Hills comprises three formations: the Canrobert, the Ibbett Bay and the Blackley.

The resedimented carbonate rocks of the Canrobert Formation (Upper Cambrian? to Lower Ordovician) are interpreted as slope deposits. They are overlain by black shales and cherts of the Ibbett Bay Formation which ranges in age from the early Ordovician to Middle Devonian, and is interpreted as a deep water basinal deposit. Above the Ibbett Bay, the Blackley Formation, comprising siltstones, mudrocks, and turbidite packages, forms the local base of the Middle Devonian clastic wedge that represents the closing phase of sedimentation in the Franklinian Geosyncline.

Résumé

La succession du Paléozoïque inférieur dans les collines Canrobert comprend trois formations: celles de Canrobert, d'Ibbett Bay, et de Blackley.

On suppose que les calcaires et dolomites resédimentés de la formation de Canrobert de (Cambrien supérieur? Ordovicien inférieur) ont été déposés dans une zone de talus. Ils reposent sous des schistes argileux et des cherts foncés de la formation d'Ibbett Bay (Ordovicien inférieur au Dévonien moyen) mise en place, selon les auteurs, dans un profond bassin de sédimentation. La formation de Blackley, caractérisée par ses <<siltstones>>, <<mudrocks>> et dépôts de courant de turbidité, constitue la base régionale du bisean clastique (Dévonien moyen) qui correspond à la phase finale de l'épisode de sédimentation du géosynclinal de Franklin.

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Introduction

A Lower Paleozoic, deep water basinal sequence on northwestern Melville Island has been divided into three formations: the Cambrian(?) to Middle Ordovician Canrobert Formation, the Middle Ordovician to lower Middle Devonian Ibbett Bay Formation, and the Middle Devonian Blackley Formation. These formations outcrop in the Canrobert Hills north of Ibbett Bay.

A detailed stratigraphic study of the formations was carried out in 1984, and samples were collected for graptolites, trilobites and microfossils. Two sections through the Canrobert and Blackley formations and three sections through the Ibbett Bay Formation were studied at three different localities (Fig. 34.1).

The field stratigraphic study is part of a Master's program at the University of Western Ontario. Guidance and advice have been provided by A. Lenz and by H.P. Trettin of Calgary, Alberta. Field work was carried out as part of the Melville project, a two-year, air-supported field program of the Geological Survey of Canada led by R.L. Christie, Calgary. The author especially appreciates the help given by Dr. Trettin during the first weeks of the field program. Sabine Fuelgen assisted cheerfully throughout the season.

Tentative age determinations for graptolites were provided by A. Lenz.

Canrobert Formation

The Canrobert Formation comprises the oldest exposures on Melville Island. The unit consists of light coloured, resistant limestone and dolostone. The lowest outcrops lie in the core of an anticline, and the base is not exposed. A trilobite collected near the lowest exposures at locality 2 is Ordovician in age (W.H. Fritz, personal communication, 1985).

The section at locality 2 is 463 m thick. The lower 365 m include light greyish yellow, flaggy weathered, interbedded calcareous and dolomitic mudrocks. The calcareous beds pinch and swell, and fine crosslaminae commonly occur in the dolomitic mudrock. The calcareous beds seem to have undergone synsedimentary deformation that has produced boudinage structures. Where this feature is well developed, there is commonly a transition into in situ breccias 0.5 to 4 m in thickness. The laminae in the dolostone are contorted around the solid clasts of limestone.

Above this lower section is a 57 m thick interval of chaotic, poorly sorted, matrix supported conglomerate. The matrix is a calcareous mudrock; clasts are subangular to subrounded, pebble to cobble sized fragments of chert and massive or flat-laminated carbonate mudrock. No bedding is present in the conglomerate, and its lateral extent is not known.

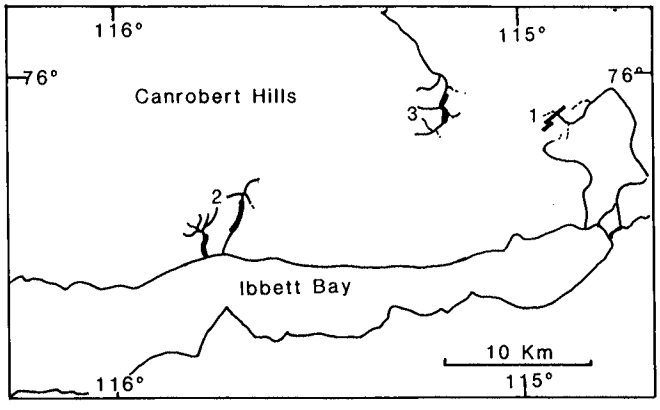

Figure 34.1. *Numbers 1, 2, 3 indicate localities of measured sections, northwestern Melville Island. Locality 3 lies on Giddy River.*

The uppermost 41 m of the section are predominately medium-grey weathered, thin bedded dolostone with minor black chert or argillaceous mudrock layers. This dolostone and chert also forms clasts in 60 to 150 cm thick beds of flat-pebble conglomerates. The conglomerate is clast supported, well sorted, and has a laminated, crosslaminated, or massive carbonate mudrock matrix.

Toward the top of the unit, a few 6 to 16 m thick intervals of black graptolitic mudrock and bedded chert suggest a gradual transition into the overlying Ibbett Bay Formation. The presence of **Isograptus** and **Tetragraptus** below the last conglomerate, which marks the upper contact, gives the upper age of the Formation as Arenigian.

At Giddy River (locality 3), the outcrops cover a stratigraphic thickness of 369 m. The limestones and dolostones are generally finer grained than those at locality 2, and no conglomerates or in situ breccia beds were found in the studied interval.

The lower 165 m consists of greyish brown, poorly bedded limestone. Packages of thin beds, 0.7 to 2 m thick, appear to form lenses that pinch out along strike. The next 204 m include alternating recessive and resistant units. The recessive units comprise 12-15 m of medium grey to yellow-grey limestone with discontinuous internal colour layering. The pinching and swelling of these beds is similar to that found in the boudinage beds at locality 2. The limestones are massive and resistant, with brownish grey weathered surfaces. Internal laminae, where present, are poorly developed. These massive units contain bioclastic "patches" that appear promising for biostratigraphic purposes.

The exact location of the upper contact of the Canrobert Formation at Giddy River is unknown because of the lack of paleontological control and the absence of conglomerates. The contact is tentatively placed at the change in rock type from massive, brownish grey limestone with bioclastic intervals to the finely laminated, dolomitic mudrock of Unit A, Ibbett Bay Formation (Table 34.1).

The presence of ripple crosslamination in dolo-arenites, and of both carbonate pebbles and black chert pebbles in the same conglomerates indicate that the carbonates of the Canrobert Formation are allogenic. The presence of very fine laminae in the dolomitic mudrocks suggests deposition from a nepheloid layer. Synsedimentary boudinage structures, and the presence of large lobes of slumped beds are attributed to downslope drag, and the thick conglomerate unit appears to be gravity emplaced. The Canrobert Formation is interpreted to be a slope deposit, the more distal version of which is at Giddy River, in the northern part of the study area. The sediments, therefore, evidently were derived from areas to the south.

Ibbett Bay Formation

The Ibbett Bay Formation is conformable above the Canrobert Formation. **Tetragraptus** and **Isograptus** are found near the base (Tozer and Thorsteinsson, 1964), and the upper contact of the formation is placed 200 m above the last occurrence of **Monograptus yukonensis.** The age range of the formation is thus Early Ordovician to late Early Devonian.

The Ibbett Bay Formation is here divided into five members, which form a sequence of alternating recessive, dark units, and more competent, light weathering units (Table 34.1, Fig. 34.2). These members appear to be mappable. The following rocks are present: thick units of

mudrocks (graptolitic shales); dolomitic mudrocks and sediment gravity flows of dolomitic material (both variably replaced by black cherts); calcareous or dolomitic concretions; and bedded black cherts. The rocks range from deeply weathered to crumbling, recessive material, and outcrops are poor.

The formation ranges in thickness from 800(?) m at Giddy River to 1175 m at locality 2, and is about 1300 m thick in the section at locality 1.

The Ibbett Bay Formation, characterized by its dark colour, pelagic fauna, primary and replacement chert, minor resedimented carbonates, and conformable relationships with the Canrobert Formation, is interpreted as a deep water basinal succession.

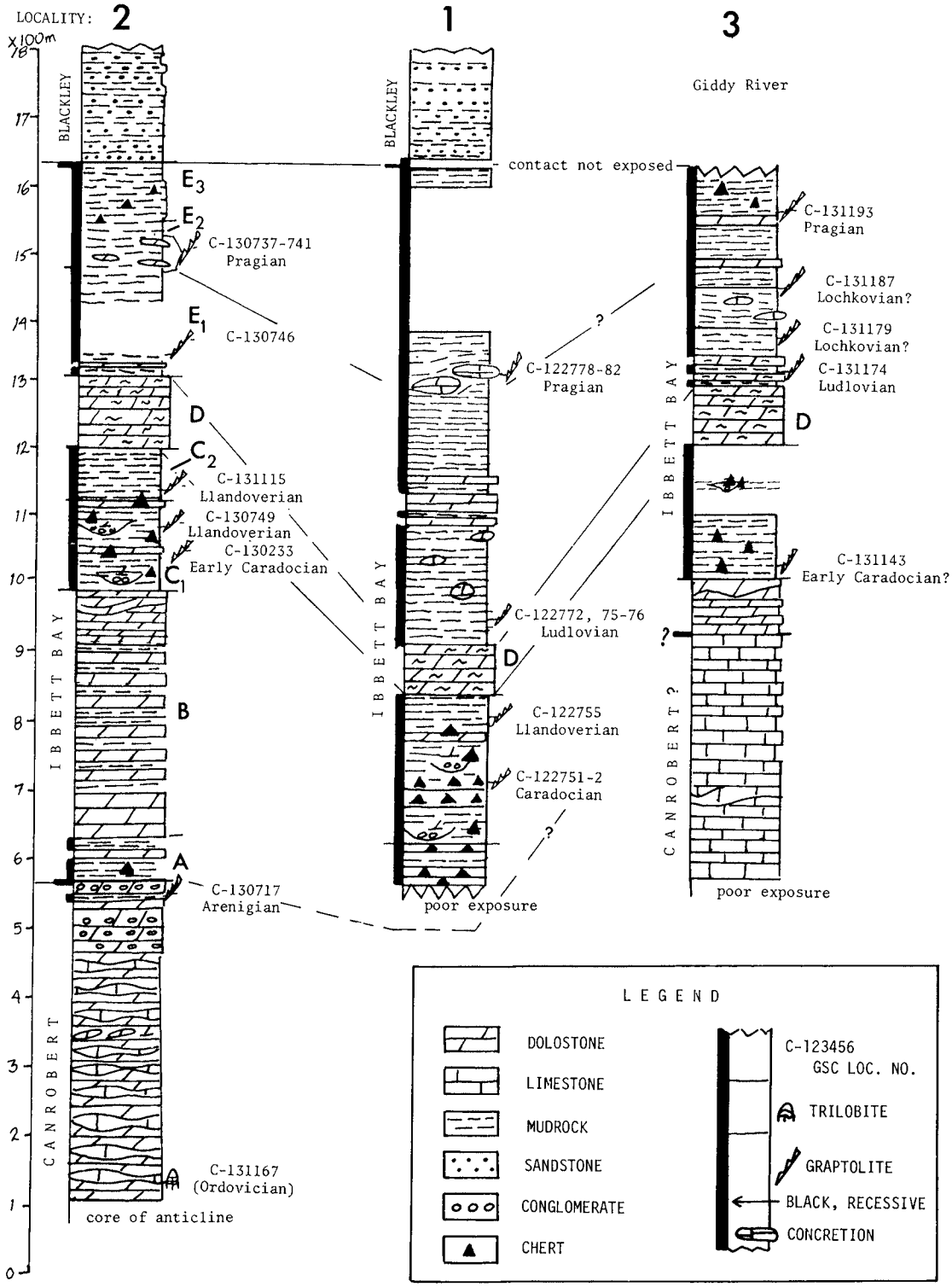

Figure 34.2. *Stratigraphic sections of lower Paleozoic formations, northwestern Melville Island. Units of the Ibbett Bay Formation are described in Table 34.1.*

Table 34.1. Generalized stratigraphy of the Ibbett Bay Formation

Unit	Lithology	Approximate thickness of unit in metres	Total thickness from base in metres
A	Mudrock: recessive, black, cherty, argillaceous (cherts apparently secondary).	60	60
B	Dolomitic mudrock: light coloured, resistant; fine laminae flat or crinkled due to soft sediment deformation.	190	250
C_1	Bedded dolostone and dolomitic sediment gravity flows (10-20 cm): conglomeratic base, minor argillaceous mudrock; variable silicification (25-40% at locality 1, 80-90% at locality 2). At Giddy River: diplograptids, colonial corals.	100	350
C_2	Mudrock: recessive, black, argillaceous; **Monograptus spiralis** toward top.	75	425
D	"Mottled dolostone": light coloured resistant marker; discontinuous inter laminae of darker, fine and coarse grained, lighter material; transition above and below into black argillaceous mudrock.	100	525
E_1	Mudrock: black, argillaceous, laminated; forms poor outcrops.	100	625
E_2	Mudrock: black, argillaceous; with concretionary beds, medium grey, resistant, 10 cm to 1 m thick; and some interbeds of lighter coloured carbonate mudrock. **Monograptus yukonensis.**	170	795
E_3	Mudrock: black, argillaceous; and bedded cherts; some rusty zones.	200	995

Blackley Formation

The Blackley Formation was most recently described by Embry and Klovan (1976). Based on 1984 fieldwork, the unit can described as follows: deeply weathered, light- to medium-grey, argillaceous and silty mudrock and sandstone, with fine- to medium-grained, rust coloured, sideritic(?) sandstones occurring as thin or irregular beds. Micaceous sandstones with pinkish grey weathered surfaces form the bases of turbidite packages. The lower sandstones have scoured bases. The turbidite cycles consist of fine sand to silt grade B-C-D or C-D Bouma sequences. The sandstones form the only prominent outcrops in the formation.

The Blackley Formation was examined in two places; at each locality, a thickness of about 210 m is exposed, and the unit is very deeply weathered. At locality 1, the basal 130 m are characterized by arhythmic alternations of 2 to 10 cm thick grey mudrock or siltstone with thin, sideritic sandstone beds. The upper 80 m comprise resistant sandstone beds, up to 1.5 m in thickness, separated by covered intervals of similar thickness. The topographic relationships suggest that the Blackley Formation is 670 m thick.

The contact between the Blackley Formation and the underlying Ibbett Bay Formation is transitional over about 2 m at locality 2. The basal 65 m consist predominantly of deeply weathered, light grey to yellowish grey, argillaceous and silty mudrock with interbeds of sideritic arenite. Any small-scale grain size variations, sedimentary structures or cyclicity are obscured. Fine grained sandstones and siltstones with fining-upward cycles are exposed from 65 m to 100 m. The upper 110 m have sporadic beds of sandstone in deeply weathered argillaceous strata.

Surface sampling of the Blackley Formation by Tozer and Thorsteinsson (1964) and by Embry and Klovan (1976) has not yielded fossils. A Givetian age is based on spores found in cores from Banks Island (Miall, 1976).

Embry and Klovan (1976) interpreted the Blackley Formation as "a submarine fan composed mainly of turbidites". It represents the earliest deposits of the Middle and Upper Devonian clastic wedge that forms the uppermost sequence in the Franklinian Geosyncline. Data are too few at present to comment on source direction.

Conclusions

Lower Paleozoic time on northwestern Melville Island is represented in part by the Canrobert Formation, the Ibbett Bay Formation, and some of the Blackley Formation.

The sequence consists of a slope deposit, followed by strata accumulated in a deep but not starved basin. More distal representatives lie to the north of proximal members. The Middle Devonian Blackley Formation represents the local beginning of the final sedimentary phase of the Lower Paleozoic geosyncline.

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